

On myself and IISc's hundred years....

Prof. H S Mukunda (retired in 2003)

My first encounter with IISc was some time in December 1962, an year before my graduation, at which time I was at Bangalore for laboratory work in Mechanical engineering (my college, National Institute of engineering, Mysore had not acquired these facilities yet). A friend of mine brought me to the Institute to meet up with his relative in Aeronautical Engineering. I was amazed and pleased to see select group of people working till later part of the day well into the night even though the rest of place was locked up and looked deserted. Having had some bad experience during industrial training in the railway workshop at Mysore, I had "decided", I would never join an industry demanding fixed timings (!) and would only join a place that allowed freedom to work away as much as needed any time desired. I simply fell in love with the Institute and I intended pursuing M E here almost instinctively. The only place I applied for was Institute with Aeronautical Engineering as the first option (In retrospect, I have often wondered about this foolish bravado for not applying to any other place). It turned out that I got direct admission (admission based on past performance – within the first three ranks in the examinations) without an interview. I have again wondered whether I would have been accepted at all if I have had to face an interview committee. I joined the Institute for M. E. in 1963. Finishing up the masters in 1965 pursued Ph. D with Prof. V. K Jain and Prof S. Dhawan as the supervisors and finished it in 1970. Joining as a lecturer in 1969 in an opportunity that got created due to demand of faculty in newer areas to cope with the new defense sponsored program on rockets and missiles, I continued till retirement at the Institute except for a two year stint at NASA Langley Research Center at Hampton, Virginia in USA and several brief visits to other countries for conferences or as a part of some delegation. It is true to say that I enjoyed the stay both as a student as well a faculty member. There were many difficult times, but I recollect no period when freedom to do what I really wanted was curtailed.

During the time I was pursuing my Ph. D., the department had a fair complement of excellent research students and particularly in fluid flows. Most of them were students of Prof. R Narasimha, Prof. M A Badrinarayan and Prof S. Dhawan. All of them were very active and my most enjoyable moments would be when we got together and talked about science, India and its problems and almost anything under the sun very intensely. Amongst the students Dr. T. S. Prahlaad and Dr. S. Vasantha went on to become directors of NAL, CSIR and SHAR centre, ISRO respectively. Others became faculty at IISc and as expected, everybody worked through at IISc till retirement.

The area of combustion or reacting flows was very new in the department. The learning of the subject was largely by intense self-reading and discussions with co-students. This self-learning that got imposed on us proved to be of great benefit in the long run since thinking through intricate new issues could be accomplished with much less external input bringing greater confidence of other academics and industries in one-self. Aeronautics in the sixties and the seventies appeared dismal with no development projects being taken up and a large number of paper exercises on the design of fighters being carried out with the Government or Air force supposedly stating that since HAL had no experience in advanced technology it would be difficult to support such a project. This got repeated several times and the joke was that every head of HAL who happened to be a senior person from air force took such a position to enable buy nice equipment from overseas and a better prospect for himself (to become the next air chief). It was clear if we have to be intellectually alive and be relevant (particularly so in Engineering) that I suppose is the aspiration of any academic, we had to think of strategies of achieving this objective. It was also a peculiar period when Ph. D from abroad (that meant usually, USA) was thought superior to Ph. D from India. Also no visionary outlook seemed available from the near surroundings. I remember one event of this period of despondency. I had been working on a set of ideas on a class of propulsion systems called hybrid rockets that

appeared very relevant to India as it was a high performing but robust and a very low cost system. To a few friends, I stated somewhat wistfully, can we not do something to such progress in some special area unique to us (but relevant to others) that demands that scientists from overseas come and learn here much like it happened in the past at Nalanda and Takshashila. A few colleagues around me looked at me peculiarly and brought me back to reality. As it turned out, of the two major activities that I was instrumental in initiating, the subject of hybrid rockets did not attract the appropriate agency subsequent to ten years of effort resulting in several publications, Ph. D for a student and occasional sporadic interest by several other agencies, but the subject of thermal conversion of solid fuels, particularly biomass has resulted in a situation that was reminiscent of Nalanda.

At the court meeting of the institute that happens in the month of March annually, there is a court lunch followed by the meeting. In the year 1981, at such a lunch, I was met by a senior colleague, Prof. Amulya K. N. Reddy who was leading a center for the Application of Science and Technology for Rural Applications (ASTRA) and asked if I could look at a technology called “gasification of solid fuels” by which process it was possible to run diesel engines to generate electricity. His idea was that India had about 3 million diesel engine pumpsets for water lifting and it would be desirable to replace as much diesel as possible by using the gasifiers. His outlook was that this would make a tremendous difference to the oil import and make the rural operations less dependent on diesel with a continuing upward trend in its price. Impressed with these thoughts, I discussed the subject with Dr. U Shrinivasa (who subsequently chose to look at biodiesel seriously at the department of Mechanical engineering) and we started working on the subject with a grant from the Karnataka State Council for Science and Technology (KSCST). By this time I had a reasonable understanding of the field of combustion, but mostly of liquid and gaseous fuels but very little of solid fuels. I thought through for myself that as an “expert” in combustion if I was posed questions of how biomass would burn and could I estimate the rate of combustion, etc, was I in a position to deal with the issues confidently. I came to a conclusion that it was clearly “No”, was ashamed of myself that I knew little on a subject so much more native than what I had looked till then.

The next five years saw serious research and development to understand the earlier work and complement it with the needed work to enable design combustion systems as well as gasification systems. More arguments were found to say why gasification of solid fuels allowed better control on combustion, emissions, and ability to produce the starting “stuff” for chemicals including bio-fuels. Systems for power levels of 5 to 100 kWe were designed, produced using a local support fabrication facility and tried out in the field under a program of the Ministry of non-conventional energy sources. One of the early milestones were reviewed by a committee chaired by Prof. Dhawan after he had retired from IISc, vigorous and as clear cut as he was when he was the director. The next ten years saw an enormous consolidation of the efforts in terms of internationalizing the knowledge base. Three international training programs were conducted. These were attended by scientists from a dozen countries both east and west. Half a dozen students came from overseas to spend months for familiarization, training and research studies. Technologies were transferred to eight licensees in India and two overseas. Engine companies like Cummins have collaborated and have for the first time in the history of gasification in the world agreed to produce and market producer gas based engines for power generation. More than fifty gasification systems with thirty five of them for electricity generation have been built. Systems of 1 MWe have been built and are operating commercially for more than three years. Every year, nearly a hundred people – a farmer to a CEO of a multi-national company visit the laboratory seeking information, knowledge, cooperative study and some, technology. There is an outstanding team of academics and researchers currently active in the field at the combustion, gasification and propulsion laboratory in the department dealing with basic research and development, solving field related problems, providing advice on new concepts of bio-residue use in electricity generation process for a rural community or an industry and of course, creating project profiles on techno-economically meaningful basis. The management is structured to operate under a society called “Advanced Bio-residue Energy Technology

Society" (ABETS) whose board chairman is the director of the Institute. Research and Development are continuing with vigour even in 2007. An effort in the last three years has led to modern gasification based cook stoves and combustion devices. Fans that are built for computers (and so of low cost) are used in carefully thought-out fluid dynamically driven designs to burn solid fuels in an efficient and environmentally benign manner. These technologies have been transferred to a multinational (BP, India) who are intending to commercially exploit it to service a huge rural market in India and other developing countries. Protecting the technology requires patenting in India and select countries (where it is perceived that the technology uptake may take place) to enable reduction in investments for maintaining the patents. The area of IPR is itself a large subject that cannot be put away as being outside the normal research and development work. There is no escape from understanding the nuances and taking protective actions in a changing world.

This pathway from a simple academic interested in publishing papers as many significant ones as possible to one who enjoys dealing with a variety of responsibilities has been thrilling to say the least. Finally, it is only appropriate to express gratitude to the institution that provided the space and time to seek fulfillment of a wide spectrum of aspirations.